LCA Documents: Overview and Announcement of Vol. 5

"The International Journal of Life Cycle Assessment" has been expanded by a book series containing material that is too long and comprehensive to be published in the journal. These LCA Documents appear irregularly as important and interesting material becomes available.

Types of Contributions:

- Original LCA Studies (full version) with a standardized, short version in English
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- Ph.D. Theses

Languages: English, French, German; **Planned Frequency:** about 4 volumes a year; **Size:** 17 x 24 cm, soft cover

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Vol. 1: LCANET
European Network for Strategic Life-Cycle Assessment Research and Development
The outcome of the LCANET initiative "A Strategic Research Programme for Life Cycle Assessment" is documented. This research programme has been sponsored by the EU, Directorate General XII to evaluate the present state of LCA and also to identify research gaps. The strategy has been coordinated by the Center for Environmental Science (CML), Leiden University, The Netherlands.
A short presentation of the LCANET strategy is published in Int.J. LCA 2 (2) 71-72 (1997).
Length: 200 pages; **Price:** DM 88,-/US $ 55.- ;
ISBN: 3-928379-53-4

Vol. 2: Eco-Efficiency Evaluation of Waste Gas Purification Systems in the Chemical Industry
Author: Markus Andreas Meier, Swiss Federal Institute of Technology, Zurich, Switzerland
Length: 270 pages; **Price:** DM 98,-/US $ 60.-;
ISBN: 3-928379-54-2

Vol. 3: Produkt-Ökobilanz vakuumverpackter Röstkaffee (Vacuum Packed Roasted Coffee; in German, with a "Standard Report Form for LCA Studies" in English); **Commissioner:** Kraft Jacobs Suchard Company; **Practitioner:** Fraunhofer Institut für Lebensmitteltechnologie und Verpackung, D-85354 Freising, Germany; **Length:** 220 pages; **Price:** DM 88,–/US $ 55.–; ISBN: 3-928379-55-0

Vol. 4: Decision Analysis as a Tool for Life Cycle ImpactAssessment
Author: Jyri Seppälä, Finnish Environment Institute, Kesäkatu 6, FIN-00260 Helsinki, Finland
Length: 180 pages; **Price:** DM 68,-/US $ 41.-;
ISBN: 3-928379-56-9

Vol. 5: **Announcement** (Publication: June 1999)

Recycling and Recovery of Plastics from Packagings in Domestic Waste – LCA-Type Analysis of Different Strategies

Authors: M. Heyde, W. Holley, M. Kremer, Fraunhofer Institut Verfahrenstechnik und Verpackung, D-85354 Freising, Germany

Length: 424 pages; **Price:** DM 98,-/US $ 60.-;
ISBN: 3-928379-57-7

1 Goal and Scope of the Study

There is a public "a priori" preference for certain recycling routes for plastics waste in Germany although there is a lack of basic information on recycling and recovery technologies. The goal of the study presented is therefore

- ❒ to inform public and governmental authorities about environmental implications of recycling and recovery processes which are already used or principally available for the treatment of plastics waste collected on behalf and under the coordination of the Duales System Deutschland (DSD) AG,
- ❒ to provide scientific information as a prerequisite for an objective comparison of these recycling and recovery processes. The study summarises the results derived from 5 projects carried out in the years of 1994 to 1996.

The following recycling strategies were examined.

Feedstock recycling:

- ❒ hydrogenation of plastics waste according to the KAB process
- ❒ reduction process according to Stahlwerke Bremen (blast furnace process)
- ❒ thermal cracking process according to BASF (pilot plant, operation will not be continued)
- ❒ gasification process according to RHEINBRAUN (high temperature Winkler process)
- ❒ gasification process according to SVZ (high pressure gasification)

Energy recovery:

- ❒ fluidized bed combustion process according to AHLSTROM (pretreated plastics waste as monofuel, pilot plant operation)

  Thermal treatment with recovery of marketable energy:
- ❒ incineration of plastics waste together with municipal solid waste in a waste incineration plant with recovery of 17 %

of electricity and of 17 % of sold thermal energy (steam)
Mechanical recycling of the bottles and film fraction, production of polymer type products:
The different mechanical recycling processes need individual waste input specifications. The following processes were examined as examples:

- recycling of the bottles fraction and production of new bottles for cleaning agents and liquid fertilizers
- recycling of the film fraction and production of new films for construction and agriculture purposes and for waste bags production
- recycling of the film fraction and production of extruded cable conduit.

Mechanical processing of the mixed plastics fraction and manufacturing of products conventionally made from wood or concrete:

- production of palisades from regranulates substituting
  - palisades made from concrete (2 different types)
  - palisades made from wood
- production of construction fence bases from regranulates substituting fence bases made from concrete.

2 Approach

On the one hand, a recycling/recovery process leads to environmental burdens resulting from resource depletion, emissions and residuals caused by collection, sorting and working up of wastes to obtain appropriate secondary raw materials or energy. On the other hand, environmental burdens will be avoided since secondary raw materials and fuels substitute primary raw materials and virgin fuels and the environmental implications connected with their conversion processes. Therefore the net effect have to be considered. Basis of all comparisons (= functional unit) has been always the production of identical types, qualities and quantities of marketable products and energy, which are manufactured either from waste or from virgin raw materials and fuels. The ecological assessment was carried out evaluating the following criteria:

- savings with regard to primary fuel,
- reduction of waste for final disposal, i. e.
  - domestic waste,
  - hazardous waste,

  and the contribution to
- global warming potential ("greenhouse effect"),
- acidification potential ("acid rain") and
- eutrophication potential ("overfertilization").

The results describe the environmentally relevant effects caused by a recycling/recovery strategy compared to conventional landfill.

3 Summarised Results

Comparison to the disposal of plastics waste by landfill shows, that

- almost all recycling/recovery processes examined (with one exception) contribute to the saving of primary energy resources,
- processes examined contribute to the reduction of the amount of domestic waste and
- processes contribute to the reduction of the acidification potential and of the eutrophication potential.

Depending on the individual recycling process, the effects on global warming potential, water consumption and the amount of hazardous wastes and radioactive waste are either reduced or increased significantly. These effects highly depend on the particular recycling strategy and on individual conditions, mainly on the type and specific amount of substituted virgin raw materials and fuels.

With respect to the criteria examined, categories like feedstock recycling, mechanical recycling and energy recovery do not generally indicate the environmentally relevant quality of a recycling / recovery strategy.

However, the results are significantly influenced by the amount and type of virgin materials substituted by plastics recycling. In the case high environmental loads will be caused by conventional manufacturing of the particular products, substitution of virgin raw materials by recyclates results in considerable savings of resources and emissions. If the environmental impact potential of conventional production is lower, the potential for savings will be also lower.

Beside the effects resulting from saving potentials of substituted "virgin material based" processes an important influence arises from waste material losses during the plastics waste refining procedures from collection up to the final recyclates (working up losses), even if part of the losses will be used in a less advanced recycling or recovery process (e. g. energy recovery instead of high end mechanical recycling).

Balancing up of environmentally relevant saving potentials from virgin material substitution versus energy and material consumption for waste upgrading is highly decisive. From those calculations one can deduct e.g. the environmental benefit of separating technically appropriate plastics fractions for mechanical recycling compared to the recycling/recovery of mixed plastics waste in so-called universal processes (feedstock recycling and energy recovery).

Mechanical recycling has the potential to achieve considerably bigger resources and emissions savings than feedstock recycling and energy recovery processes, if the recyclates replace virgin plastics material with a near to 1:1 mass ratio and provided that the working up losses are low.

If recyclates substitute concrete or wood, the saving effects are in general considerably lower than in the case of feedstock recycling or energy recovery, disregarding special cases.

Energy recovery becomes comparable to feedstock recycling if the available energy (mainly heat) will replace heat from virgin fuels to a high extent.

It has to be pointed out that these findings have been derived from the evaluation of a limited number of criteria of environmental impact potentials. Aspects like toxic emissions have been neglected due to an incomplete and asymmetrical data base.